Comments on Draft 2022 Update Scoping Plan
Gary Latshaw, Ph.D., Staff Scientist at Securethefuture2100
May 23,2022

I encourage CARB to adopt the most aggressive Alternatives (One and Two). Climate Scientist have done an excellent analysis of projecting the global temperature rise with greenhouse gas emissions, but they have seriously underestimated the actual impacts to the climate. We are witnessing flooding, droughts, wildfires, intense storms, unseasonable cold spells, and other phenomenon much quicker than expected[1]

We have only recently begun to detect the extent of natural gas leakage from the site of extraction to the location of use (see Appendix). Consequently, the use of the natural gas – primarily methane- is accompanied by climate impacts much beyond the carbon dioxide emissions resulting from combustion. To the credit of the Scoping Plan Draft's authors, this phenomenon is reflected in the text. I bring it to your attention to state that regulations should emphasize the need to constrain and eliminate methane.

Electrification of buildings is an essential element to achieve substantial reduction/elimination of greenhouse gases. Since vehicles only last for seven to ten years, they can be relatively easily replaced with zero-emission vehicles as they become available. However, buildings last on the order of centuries so it is essential to have programs that will retrofit them rapidly. The recent explosion in options for electric vehicles is a demonstration that investment and incentive programs for alternative energy devices can be successful. Most experts believe that ultimately electric vehicles will be cheaper to produce and maintain without that assistance.

I strongly recommend that CARB adopt a **"End of Gas Flow"** policy to make a very explicit and easily understood statement on the elimination of natural gas usage. Bill Mckibben, the respected science writer has written elegantly and concisely **"Going Slowly is Losing."**

[1] Corbett, Jessica, Climate Expert Debunks Big Oil's Lies About Carbon Capture, Nature-Based Solutions, Common Dreams, February 8,2022

The GHG emission factors used do not account for the serious leakage of natural gas associated with natural gas combustion. The emission factors used in the CAP appear to be based on the simple assumption that each molecule of methane (the primary component of natural gas) combusts and forms one molecule of carbon dioxide and two molecules of water. umber based on the simple assumptions.

Unfortunately, there is substantial leakage associated with the use of natural gas and that leakage has not been accounted for in the emission factor used in the Draft CAP. The various sources of leakage are shown in the Figure 2 below.

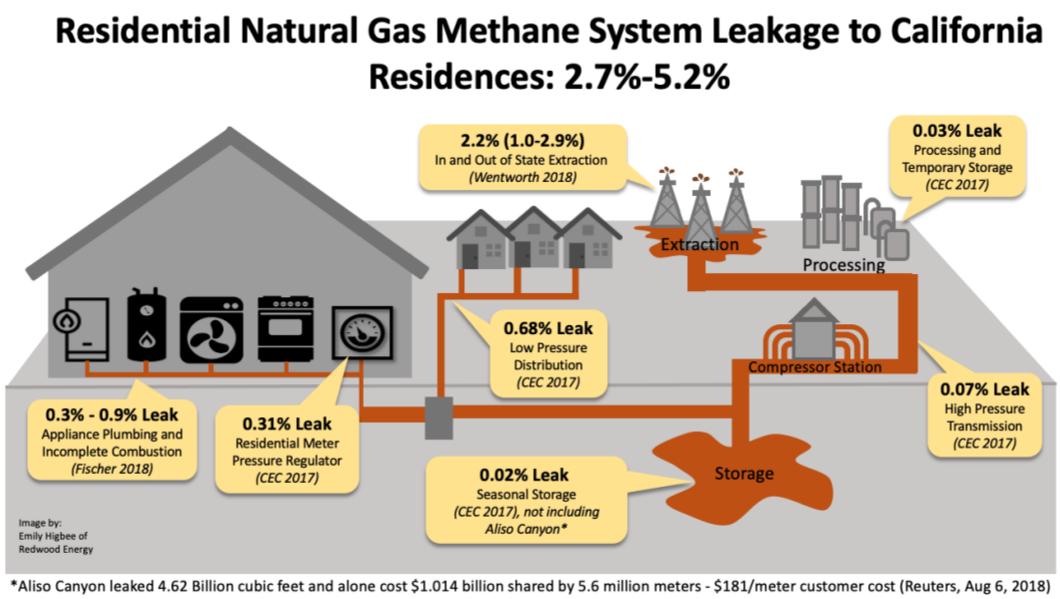

Figure 2 – Diagram of leakage from various sources in a building and exterior to the building from the supply and processing infrastructure. [2] The origin of the values are from Navigant, Redwood Energy, CPUC, PG&E, CED, Wintworth, and CEC.

[2] Slides produced by Redwood Energy

Appendix on Natural Gas Leakage

The San Francisco produced a study[3] of natural gas leakage in 2017. Here is a table from that report:

TABLE 1: LITERATURE REVIEW ON METHANE LEAKS FROM NATURAL GAS SYSTEMS

Study	Percent Leak	Min Leak	Max Leak	Production Type	Analysis Type	Year
EPA GHGI*[i]	1.37%	1.11%	1.78%	All production	Bottom-Up	2014
Brandt*[ii]	2.35%	1.96%	2.75%	All production	Top-Down	2014
Miller*[iii]	3.57%	2.74%	4.40%	All production	Top-Down	2013
Caulton et al[iv]	7.00%	2.30%	11.70%	All production	Lit Review	2014
Burnham[v]	2.75%	0.97%	5.47%	Conventional	Lit Review	2011
Howarth[vi]	3.80%	1.70%	6.00%	Conventional	Lit Review	2011
Burnham[vii]	2.01%	0.71%	5.23%	Shale	Lit Review	2011
Howarth[viii]	5.80%	3.60%	7.90%	Shale	Lit Review	2011
Howarth[ix]	12.00%	4.30%*	19.70%*	Shale	Lit Review	2015
Averages	*4.52%*	*2.15%*	*7.21%*			

Additional data points were estimated by the San Francisco Department of the Environment

Figure 3 – Screen Grab from referenced study

As seen in the table, the leakage estimates, and measurements vary substantially among the various investigations. For further calculations, we will use the average value of 4.52%.

Incorporating the consequences of leakage into the CAP building GHG emissions causes the amount originally associated with the emissions to increase by a factor of 2.41. Although the percent of leakage is 4.52%, methane has a very large global warming potential of 86 over a 20-year period according to the IPCC Third Assessment Report. Since we are dealing with an even shorter period ~ 10 years, this value is reasonable. Incorporating the effects of leakage result in the charts[4] in Figure 1.

---

[3] Wentworth, Naomi, etal, *Methane Math: How Cities can Rethink Emissions from Natural Gas*, Prepared by San Francisco Department of the Environment, November 2017

[4] If we assume that 4.52% of the natural gas in one therm leaks, this will imply that a multiplier must be incorporated in the GFG emission factor

1. Mass of CO_2 from combusting 100cf (2.83X10^3 liters) is 126 moles. One therm is about 100cf. The atomic weight of CO_2 is 44.01. Multiply 44.01 by the number of moles is 5.54x10^3 grams.
2. GWP = 5.54X10^3 X 1 = 5.54X10^3. The Greenhouse Warming Potential of CO_2 is 1.
3. If 4.52% leak is associated with this therm of CH_4, then 4.52% of the methane will be released: 0.0452 x 126x16 = 9.11x10^1grams. The atomic weight of CH_4 is 16.

4. From Google/IPCC: Methane has a potential of 25 over 100 years (GWP_{100} = 25) but 86 over 20 years (**GWP_{20} = 86**); (IPCC Third Assessment Report). So the GWP is 9.11x10^1x86=7.83x10^3

7.83x10^3/5.54X10^3 = 1.41 or 2.41 times the warming impact of the combusted CH4.